

WHAT IS CLAIMED IS:

1. An actuator apparatus for manipulating a controlled object, the actuator comprising:

a motor having a spindle;

a control shaft actuated by the spindle, wherein the control shaft reciprocates in its axial direction so as to determine a manipulating amount of the actuator apparatus depending on an axial position thereof;

a drive cam having a rotation axis parallel with an axis of the spindle of the motor, wherein the rotation axis of the drive cam is perpendicular to an axis of the control shaft so that the drive cam reciprocates the control shaft perpendicularly to the axis of the spindle of the motor in accordance with a profile of a peripheral surface of the drive cam while the drive cam rotates; and

a reduction section using a spur gear for transmitting torque of the motor to the drive cam.

2. An actuator apparatus according to claim 1, further comprising:

stoppers respectively provided on both sides of the spur gear with respect to an axial direction of the spur gear; and

protrusions respectively formed on both sides of the spur gear with respect to an axial direction of the spur gear, each protrusion is respectively received by corresponding stopper for defining a rotation range of the spur gear,

wherein:

the spur gear coaxially rotates with the shaft of the drive cam;

a rotation angle of the drive cam is restricted at one end of the rotation range of the spur gear and at the other end of the rotation range of the spur gear.

3. An actuator apparatus for manipulating a controlled object, the actuator comprising:

a motor having a spindle;

a control shaft actuated by the spindle, wherein the control shaft reciprocates in its axial direction so as to determine a manipulating amount of the actuator apparatus depending on an axial position thereof;

a drive cam having a rotation axis parallel with an axis of the spindle of the motor, wherein the rotation axis of the drive cam is perpendicular to an axis of the control shaft so that the drive cam reciprocates the control shaft perpendicularly to the axis of the spindle of the motor in accordance with a profile of a peripheral surface of the drive cam while the drive cam rotates;

a transmission device joined with the control shaft overlapping each other where the axis of the drive cam is arranged perpendicularly to an axis of the control shaft; and

a sliding member included in the transmission device with the drive cam, wherein the sliding member and the drive cam transfers the rotation of the drive cam into a

reciprocating motion of the control shaft while contacting and sliding each other.

4. An actuator apparatus for manipulating a controlled object, the actuator comprising:

- a motor having a spindle;

- a control shaft actuated by the spindle, wherein the control shaft reciprocates in its axial direction so as to determine a manipulating amount of the actuator apparatus depending on an axial position thereof;

- a drive cam having a rotation axis parallel with an axis of the spindle of the motor, wherein the rotation axis of the drive cam is perpendicular to an axis of the control shaft so that the drive cam reciprocates the control shaft perpendicularly to the axis of the spindle of the motor in accordance with a profile of a peripheral surface of the drive cam while the drive cam rotates; and

- an angular sensor using a Hall element for detecting a rotation angle of the drive cam without contacting,

- wherein:

- a detection range of the rotation angle of the drive cam is less than  $90^\circ$ .

5. An actuator apparatus for manipulating a controlled object, the actuator comprising:

- a motor having a spindle;

- a control shaft actuated by the spindle, wherein the

control shaft reciprocates in its axial direction so as to determine a manipulating amount of the actuator apparatus depending on an axial position thereof;

a drive cam having a rotation axis parallel with an axis of the spindle of the motor, wherein the rotation axis of the drive cam is perpendicular to an axis of the control shaft so that the drive cam reciprocates the control shaft perpendicularly to the axis of the spindle of the motor in accordance with a profile of a peripheral surface of the drive cam while the drive cam rotates; and

an electromagnetic clutch mounted on the actuator, wherein the electromagnetic clutch allows rotation of the motor when the electromagnetic clutch is energized, and the electromagnetic clutch disengages rotation of the motor when the electromagnetic clutch is de-energized.

6. An actuator apparatus disposed in an engine for manipulating a valve lift comprising:

An actuator for manipulating a controlled object, the actuator including:

a motor having a spindle;

a control shaft actuated by the spindle, wherein the control shaft reciprocates in its axial direction so as to determine a manipulating amount of the actuator apparatus depending on an axial position thereof; and

a drive cam having a rotation axis parallel with

an axis of the spindle of the motor, wherein the rotation axis of the drive cam is perpendicular to an axis of the control shaft so that the drive cam reciprocates the control shaft perpendicularly to the axis of the spindle of the motor in accordance with a profile of a peripheral surface of the drive cam while the drive cam rotates;

a valve cam for opening and closing one of an intake valve and an exhaust valve of the engine; and

a lift controller for controlling one of a lift of an intake valve and a lift of an exhaust valve by adjusting the valve cam in accordance with an axial position of the control shaft.

7. An actuator apparatus according to claim 6, wherein:

the drive cam has a rotation range, wherein a vicinity of one end of the rotation range corresponds to a lift of one of the intake valve and a lift of the exhaust valve when the engine is idling;

the drive cam has a cam lift which determines reciprocating amount of the control shaft, wherein a rate of change of the cam lift varies while the drive cam rotates in the rotation range; and

the drive cam has a profile, wherein a rate of change of the cam lift while the drive cam rotates in a rotation range around one end of the rotation range is smaller than a rate of change of the cam while the drive cam rotates in a

rotation range beginning at the end of the range around the one end and progressing toward the other end of the rotation range.

8. An actuator apparatus according to claim 6, wherein:

the drive cam has a rotation range, wherein a vicinity of one end of the rotation range corresponds to a lift of one of the intake valve and a lift of the exhaust valve when the engine is idling;

the drive cam has a cam lift which determines reciprocating amount of the control shaft, wherein a rate of change of the cam lift varies while the drive cam rotates in the rotation range; and

the drive cam has a profile, wherein a rate of change of the cam lift once increases, subsequently decreases while the drive cam rotates from one end of the rotation range toward the other end of the rotation range.